

<b>Report Documentation Page</b>			<i>Form Approved OMB No. 0704-0188</i>		
<p>Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.</p>					
1. REPORT DATE <b>2011</b>	2. REPORT TYPE	3. DATES COVERED <b>00-00-2011 to 00-00-2011</b>			
4. TITLE AND SUBTITLE <b>PAC-3: The Evolution of a System from Concept to Deployment</b>			5a. CONTRACT NUMBER		
			5b. GRANT NUMBER		
			5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S)			5d. PROJECT NUMBER		
			5e. TASK NUMBER		
			5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>U.S. Army Space and Missile Defense Command/Army Strategic Forces Command, Future Warfare Center, 1330 Inverness Drive, Suite 440, Colorado Springs, CO, 80910</b>			8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)		
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)		
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>Same as Report (SAR)</b>	18. NUMBER OF PAGES <b>2</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			



# PAC-3

## The Evolution of a System from Concept to Deployment

Sharon Watkins Lang  
USASMDC/ARSTRAT Command Historian

This command and the Air Defense Artillery have been linked essentially from the beginning of our organization. The Nike-Zeus system was in some respects a follow-on to the existing Nike series of weapons – Ajax and Hercules. The Safeguard system deployed in 1975 was a part of the defensive network. And more recently, the Ground-based Midcourse Defense (GMD), manned and operated by USASMDC/ARSTRAT Soldiers, has its technological roots within the command as well. However, as we mark the 20th anniversary of Operation Desert Storm it is fitting to focus upon the theater and one of USASMDC/ARSTRAT's contributions to the fight.

Even as the then U.S. Army Strategic Defense Command (SDC) led the effort to research and develop, test and evaluate a strategic defense system, they began to investigate the theater applications of missile defense. In December 1985, the command began to develop a series of theater missile defense architectures. In June 1986, Defense Secretary Casper Weinberger relayed Europe's increasing concerns of the "growing threat posed in the chemical, nuclear, and especially conventional areas by increasingly accurate Soviet short-range missiles." Secretary Weinberger further directed that we "explore 'specific ways in which the U.S.-led SDI [Strategic Defense Initiative] research program [could] assist the NATO extended air defense efforts in which the Europeans are taking a leading role.'" <sup>1</sup> By the end of the year, seven contracts were in place with teams from Germany, France, Italy, Great Britain, Israel and the U.S.



The PAC-3 was declared combat ready in August 2002 and is deployed against tactical ballistic missiles, cruise missiles and air breathing threats.

Army Artist SFC Sieger Hartgers captures a Patriot site in Saudi Arabia during Operation Desert Shield (1990).



The "Enhanced Patriots" deployed during Operation Desert Storm incorporated missile defense technology developed by the command for its national and theater missile defense missions.

## » OPERATION DESERT STORM AND NEW DEFENSE POLICY

As the nation prepared for war in 1990, with only three years of R&D behind them, no systems specifically designed for TMD were available. The nearest solution was the Patriot anti-tactical ballistic missile capability 2, designed by the U.S. Army Missile Command. Developed to counter the growing threat of tactical ballistic missiles, however, the Patriot Advanced Capability 2 or PAC-2 was not yet scheduled to begin production, let alone deployment.

In the autumn of 1990, the PAC-2 was rushed into production. To expedite this effort, technologies, to include software and components, developed for SDC's hit-to-kill TMD programs were diverted to the PAC-2. Even as the PAC-2 deployed, research continued to field a more effective system. During Desert Shield/Desert Storm six different versions of the Post Deployment Build-3 software were fielded to increase the probability of a warhead kill.<sup>2</sup>

In contrast to SDC's interceptors, the PAC-2 was designed to maneuver close to the incoming target and detonate its own warhead to destroy it and its components. Deployed to provide air defense for ports, airfields, logistical bases and command and control centers, 3000 + Patriot missiles (Patriot, PAC-1 and PAC-2) were transferred to the battlefield. During the war, 158 PAC-2s were launched against Scud targets. Although there is some debate about the success of their performance, they did herald a new beginning in missile defense. Following the Persian Gulf War, there was an increased interest in the research, development, test and evaluation of TMD systems.

## » ERINT BECOMES PAC-3

In the early 1980s, the command conducted the Flexible Lightweight Agile Guided Experiment (FLAGE). Like the Homing Overlay Experiment before it, the FLAGE demonstrated the feasibility of "hitting a bullet with a bullet", in this case an endo-atmospheric or short range bullet. The Extended Range Interceptor or ERINT, a follow-on to the FLAGE, incorporated such component upgrades

as miniaturized components, aerodynamic fins and attitude control motors which extended its range. Following a 1989 final design review, officials concluded that this high velocity hit to kill missile would be used primarily against maneuvering tactical missiles and secondly against air-breathing aircraft and cruise missiles. Elevated to project status in 1992, the ERINT successfully completed intercepts of theater ballistic missile targets with simulated bulk chemical warheads and an air-breathing drone in 1994.

At this point the ERINT was pitted against a proposed upgraded Patriot/PAC-2. The Acquisition Review Council subsequently concluded in favor of the ERINT as the new PAC-3 interceptor. Based upon the ERINT's reduced size, half that of the Patriot, the council observed that it offered "increased range, accuracy and lethality." With these decisions, ERINT officially merged with the Patriot Project Office and became the new interceptor for the PAC-3 in 1994.

The Army ultimately pursued a three-phased deployment for the PAC-3. In December 1995, the first units received a PAC-3 Configuration 1, which incorporated the guidance enhanced missile or Patriot GEM and improvements to the BMC<sup>3</sup>I. The Configuration 2, fielded in 1998, used both PAC-2 and GEM missiles and included upgrades to the radar, communications and other systems. In Configuration 3, the Army introduced the new hit-to-kill missile, and made additional improvements to the AN/MPQ-65 radar, communications and ground support.<sup>3</sup> Following a series of production flight and intercept tests, the PAC-3 Configuration 3 was deployed to the 108<sup>th</sup> Air Defense Artillery Brigade in March 2000, with the first of the new missiles delivered in September 2001. Ultimately, the Pentagon declared the PAC-3, a system consisting of a launcher with up to 16 missiles, a radar, a fire control station, a power supply and communication relays, combat ready in August 2002. It was first used in combat five years later against Iraqi short-range SSMS during Operation Iraqi Freedom.

This milestone by no means marks the end of the story. A technology first conceived in the 1970s and tested in the 1980s continues to evolve. Research and development seeks to further improve the PAC-3 and its support systems. 

### Footnotes

1 Memorandum from the Secretary of Defense to the Director, SDIO quoted in James Walker, Lewis Bernstein and Sharon Watkins Lang, *Seize the High Ground – The U.S. Army in Space and Missile Defense* (Washington, DC: GPO, 2005), p. 176.

2 "The Patriot Air Defense System," Appendix A "The Whirlwind War" <http://www.fas.org/spp/starwars/docops/wwwapena.htm>.

3 The final version of the PAC-3 uses hit-to-kill technology enhanced with a small fragmentation warhead. The upgraded radar provides improved detection and discrimination in densely cluttered environments.